Appendix E

Traffic Operations Anaylsis

Appendix E contains Traffic Operations Analysis summary prepared by W&H Pacific in support of the US 95 Coeur d'Alene Corridor Plan.

Overview

The US 95 Coeur d'Alene Corridor Plan process identifies a number of future improvement options, including various alternative route and expressway improvements to US 95. Future traffic conditions will vary greatly for many of the existing US 95 highway sections, depending on the assumed highway design, system connections and local arterial improvements assumed for each of the options. Furthermore, given the variation of the existing US 95 highway design, a number of analytical tools are required to more accurately and consistently measure traffic performance. Our analysis employs use of five procedures outlined in the *Highway Capacity Manual* (HCM) to test various improvement options as noted in Table 1.

Table 1

Analysis Procedures

Appendix Report	Study Segment	*Highway Capacity Manual* Procedure	Study Options
Part 1	Coeur d'Alene/Hayden	Freeway operations	US 95 Expressway options
Part 2		Signalized intersection operations	All options
Part 3		Signal system operations (Synchro)[1]	Interim signal system improvements
Part 4	Ironwood	Unsignalized intersection operations	All options
Part 5	Mica Creek/Cougar Gulch	Rural highway operations	All options

1. Synchro is a traffic analysis tool used to evaluate signal systems based on HCM procedures.

Each segment and the corresponding analyses are described below to include: (1) purpose; (2) methodology(s) used; (3) assumptions; (4) forecast volumes; and (5) results. Detailed LOS calculations are provided in a supplemental report titled **Traffic Operations Analysis – LOS Worksheets**.

General Findings

The traffic analysis is incorporated in the US 95 Coeur d'Alene Corridor Plan, and reflects a number of major findings as summarized below.

- For the US 95 Expressway options, future (year 2020) peak hour traffic operations will work within accepted levels of service (LOS "D" or better) on:
  1) Expressway sections (mainline and ramp merge and diverge areas) of US 95 north of I-90 (see Part 1).
  2) Major signalized intersections along US 95 (see Part 2).
- The current US 95 signal system (between Ironwood Avenue and Hayden Avenue) is already optimized (see Part 3).
- Until a long-term US 95 corridor solution is defined, approved and constructed, the best interim traffic control improvement along US 95 (between I-90 and SH-53) is to
  1) Complete planned local arterial widening projects that add side-street capacity to US 95 traffic operations (see Part 3).
  2) Install ITS technology and add additional traffic signals (when warranted) at a minimum spacing of ½-mile (including a new traffic signal at Wilbur Avenue) (see Part 3).
- For all improvement options the future level of service of unsignalized intersections along US 95 between Ironwood Avenue and Harrison Street will operate within acceptable LOS (see Part 4).

Part 1 Freeway Operations Analysis – Expressway Options

Purpose

To ascertain the performance of the US 95 Expressway options based on future traffic operations. The analysis of the expressway options focused on the section of US 95 between (and including) Kathleen and Hayden Avenues.

Methodology

For the analysis of the levels of service for the proposed expressway section of US 95, the methodologies presented in the 2000 *Highway Capacity Manual* (HCM) were used through the application of the Highway Capacity Software (HCS). The 2000 HCM methodology was used because at the time this analysis was performed it represented the current version, and its use has been adopted throughout the industry. The freeway analysis is independent from the intersections analysis, which was performed using the 1997 HCM, the adopted standard at the time the analysis was initiated. Although the main reason for the use of the 2000 HCM is its prevalence, it also provides a major benefit over the 1997 HCM for the analysis of freeways, in that it is able to perform an analysis on a freeway facility rather than looking at the individual segments (i.e., independent examination of merge and diverge points, and mainline segments). The 2000 HCM freeway analysis ensures that operations are acceptable along an extended section of freeway, and accounts for blockages/queuing that may occur and its impacts to the facility as a whole.

A freeway "facility" is a series of several connected freeway segments including basic freeway segments, ramp segments, and weaving segments. The analysis of a freeway facility is performed by direction, and integrates the methodologies used to analyze the individual segments from which the facility is composed. The analysis is segmented in 15-minute intervals to account for fluctuation in traffic volumes during an analysis period. The first stage of the analysis is to determine if each direction of the facility is undersaturated or oversaturated for each time period. For a facility to be undersaturated, each segment of the facility must have a demand/capacity ratio of less than 1.0. This indicates that no bottlenecks exist within the facility and the analysis can proceed by calculating operations for each of the individual segments that make up the facility. Based on our analysis, all segment are expected to operate with undersaturated conditions during all the analyzed time periods. Thus the analysis of the individual segments is appropriate in this case. The US 95 expressway improvement option(s) are comprised of basic freeway segments and ramps. The methodologies for these are described below.

The mainline analysis was conducted using the freeway module included in HCS. This focuses on a section of the mainline, that is outside the influence area of ramps and weaving sections. Levels of service for mainline sections are based on the density of vehicles per mile per lane on the mainline. The levels of service corresponding to each density are shown in Table 2.

Table 2

HCS Freeway Mainline Level of Service Standards

LOS[1]	Density Range[2]
A	0-11
B	>11-18
C	>18-26
D	>26-35
E	>35-45

The remaining assumptions apply to the spacing of the ramps. For simplicity, it was assumed that all the ramps would have identical designs, with acceleration/deceleration lengths of 500 feet and spacing between adjacent ramps (pairs of on- and off-ramps located at the same interchange) of 1,000 feet.

Forecast Volumes

The analysis of the operations on the expressway mainline and its ramps was conducted for the section from south of Kathleen Avenue to the north of Hayden Avenue, and included the analysis of the four interchanges at Kathleen, Hanley, Prairie, and Hayden Avenues.

This portion of the US 95 corridor, north of I-70, has the heaviest travel volume projections for the 20-year planning horizon. North of Hayden Avenue, the background land development plans and resulting traffic conditions are significantly lower. Our assumptions of the analysis is that future expressway operations would be better north of Hayden Avenue than for the segment between Kathleen and Hayden Avenues.

The analysis was conducted for the future (2020) PM peak hour, for two of the future improvement options: (1) US 95 Expressway with frontage roads and local arterial improvements; and (2) US 95 Expressway with frontage roads, local arterial improvements and the Huetter Road Alternate Route (with Southern Extension). The Kootenai County Regional Travel Demand Model was used to derive 2020 PM peak hour traffic volumes for each option.

Results

The analysis showed that for both options, traffic in the northbound travel direction is heaviest on the US 95 Expressway and frontage road system. The analysis also showed that when treated as a freeway facility, both directions of travel for both options operate with globally undersaturated conditions during the analysis period. Therefore, the operations analysis proceeded using the methodologies published for basic freeway segments and ramps. For Option 1 (US 95 Expressway), both the northbound and southbound directions are expected to operate at LOS D or better in 2020. For Option 2, the US 95 Expressway, the alternative with the Huetter Road alternate route is anticipated to operate at LOS D or better in the northbound direction, and at LOS C or better southbound.

Exhibits 1a and 1b show a detailed LOS summary for each option, and the traffic volumes used in their analysis.

US 95 Expressway with Frontage Roads and Local Arterial Improvements and the Huetter Road Alternate Route- Southern Extension

Exhibit 1B

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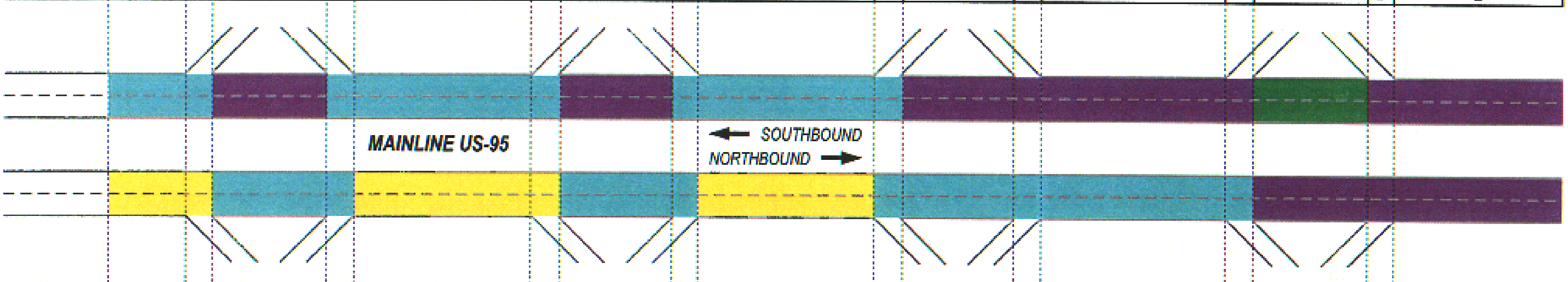
		KATHLEEN				HANLEY				PRAIRIE				HAYDEN			
VOLUME	2,439	623	1,816	635	2,452	653	1,799	531	2,330	877	1,454	340	1,794	712	1,082	201	1,283
LOS	C	C	B	C	C	C	B	C	C	C	B	B	B	B	A	B	B



VOLUME	3,120	771	2,349	746	3,095	610	2,484	559	3,043	1,082	1,961	407	2,368	901	1,467	297	1,764
LOS	D	D	C	C	D	D	C	C	D	C	C	C	C	C	B	B	B
		KATHLEEN				HANLEY				PRAIRIE				HAYDEN			

*Frontage Lanes not included in expressway LOS analysis
*Volumes Represent Weekday PM Peak Hour
*Analysis performed using 2000 HCM Methodologies

= LOS A
= LOS B
= LOS C
= LOS D
= LOS E
= LOS F

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Assumptions

It was assumed that the existing intersection traffic control, lane geometry and input parameters (signal timing, peak hour factors, and heavy vehicle percents) remains for each of the future improvement options at the Appleway Avenue and Ironwood Avenue intersections. Separate tests were performed at each of these intersections to identify specific turn-lane improvement needs commensurate with the expressway improvement options.

For Hanley and Prairie Avenues, the future expressway options would significantly alter the existing highway, intersection, circulation, and access design. Because of the extensive reconfiguration of these intersections, all operational parameters were adjusted (i.e., intersection splits, cycle lengths, and phasing). For those options that would only modify intersection geometry and phasing, the existing cycle lengths were monitored but the intersection splits were re-optimized.

Forecast Volumes

The analysis of the operations at each of the critical intersections was conducted for the future (2020) PM peak hour, for each of the future improvement options. The Kootenai County Regional Travel Demand Model was used to derive 2020 PM peak hour traffic volumes for each option.

Results

The summary of the results of the signalized intersection LOS analysis are shown on Exhibit 2a. Exhibits 2b through 2e show the results for the individual intersections in more detail. It can be seen that under the US 95 Expressway (with frontage roads and local improvements) that the frontage road intersections at Hanley and Prairie Avenues are expected to operate at LOS D or better. The intersections at Appleway and Ironwood Avenues, which would not be improved under this option, will operate at LOS F. With the addition of a second eastbound left turn lane and exclusive westbound right-turn lane and optimized of the signal timing, future traffic operations at Ironwood Avenue will improve to LOS D. At the Appleway Avenue intersection, optimization of the signal timing, and the addition of an exclusive westbound right turn lane will improve intersection operations to LOS D, with all individual movements at LOS D or better.

Evaluation of Improvement Options
2020 Traffic Operations - Example Site Prairie Avenue

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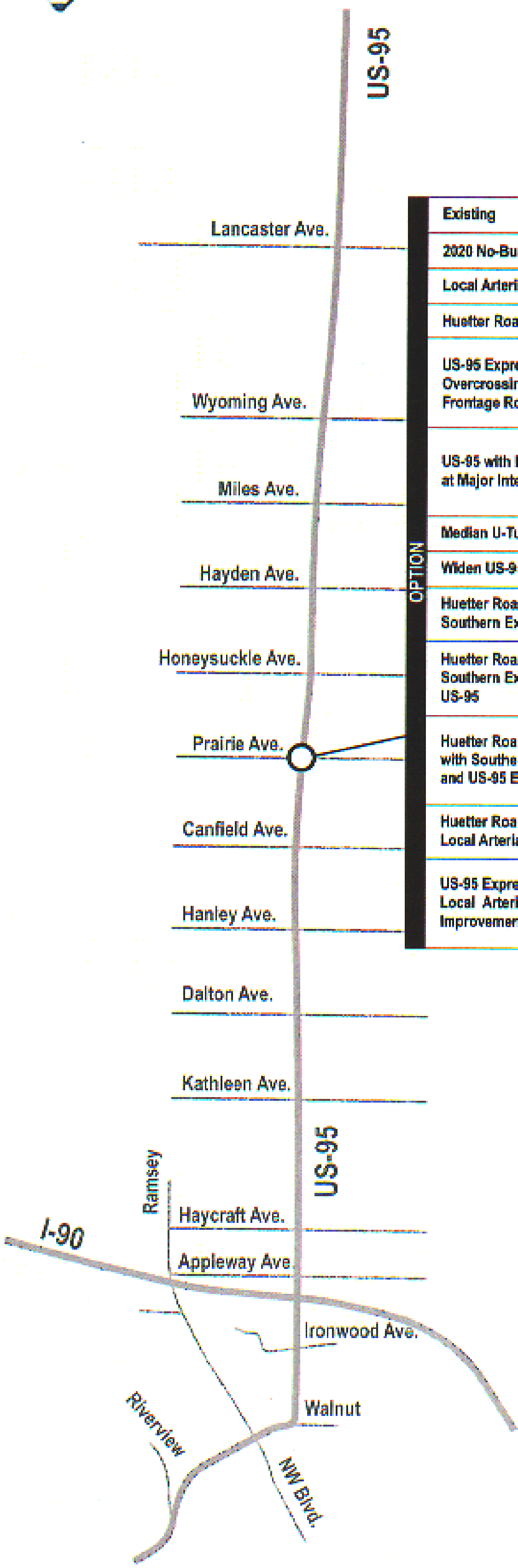
Exhibit 2B



OPTION		INTERSECTION TOTAL	EB LEFT	EB THROUGH	WB LEFT	WB THROUGH	NB LEFT	NB THROUGH	SB LEFT	SB THROUGH
Existing		E / 57.3	F / 102.0	E / 61.5	E / 64.6	E / 57.3	F / 161.1	C / 29.7	F / 272.6	D / 37.6
2020 No-Build		F / 116.1	F / 204.0	F / 190.7	E / 68.2	F / 107.7	F / 183.0	B / 20.0	F / 233.2	F / 149.1
Local Arterial Improvements		F / 81.2	F / 150.9	F / 129.4	E / 77.4	E / 79.2	F / 126.7	C / 22.4	F / 174.0	F / 94.1
Huetter Road Alt Route		E / 62.8	E / 79.3	E / 79.2	D / 51.2	E / 71.2	E / 79.4	E / 79.2	E / 79.2	D / 37.3
US-95 Expressway with Overcrossings and Frontage Roads	NB FRONTAGE ROADS	D / 45.7	D / 53.6	B / 11.8		D / 52.6		D / 51.3		
	SB FRONTAGE ROADS	C / 33.8		D / 53.3	D / 53.6	A / 8.4				C / 20.5
US-95 with Interchanges at Major Intersections	NB RAMPS	E / 63.6	F / 151.4	C / 25.8		F / 88.3	B / 10.9			
	SB RAMPS	C / 25.0		C / 34.0	C / 34.4	A / 3.7			C / 34.6	
Median U-Turns at Major Intersections		D / 49.4		E / 77.7		F / 109.9		E / 56.5		A / 3.6
Widen US-95 to 6-Lanes		F / 91.4	F / 170.0	F / 146.2	E / 72.8	E / 71.8	F / 148.6	F / 116.7	D / 44.5	D / 49.8
Huetter Road Alt Route with Southern Extension		E / 74.0	F / 119.1	F / 87.4	E / 78.2	E / 76.9	E / 68.6	F / 114.5	D / 48.5	D / 38.1
Huetter Road Alt Route with Southern Extension and 6-Lanes on US-95		E / 66.1	F / 110.1	F / 78.0	E / 74.3	E / 75.4	E / 61.6	F / 93.8	D / 45.6	D / 38.3
Huetter Road Alt Route with Southern Extension and US-95 Expressway	NB FRONTAGE ROADS	D / 39.8	D / 51.1	B / 11.3		D / 47.9		D / 45.4		
	SB FRONTAGE ROADS	C / 30.6		D / 44.9	D / 48.4	A / 8.2			C / 22.0	
Huetter Road Alt Route with Local Arterials		E / 55.6	F / 103.9	E / 73.5	E / 70.4	E / 61.1	E / 60.6	C / 30.3	F / 216.2	D / 47.1
US-95 Expressway with Local Arterial Improvements	NB FRONTAGE ROADS	D / 44.3	D / 53.8	B / 13.4		D / 52.0		D / 50.6		
	SB FRONTAGE ROADS	C / 31.2		D / 43.5	D / 48.1	A / 8.0				C / 26.4

X / X = LOS / VEHICLE DELAY (SECONDS PER VEHICLE)

- = LOS A
- = LOS B
- = LOS C
- = LOS D
- = LOS E
- = LOS F

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Evaluation of Improvement Options
2020 Traffic Operations - Example Site Appleway Avenue

DISTRICT 1
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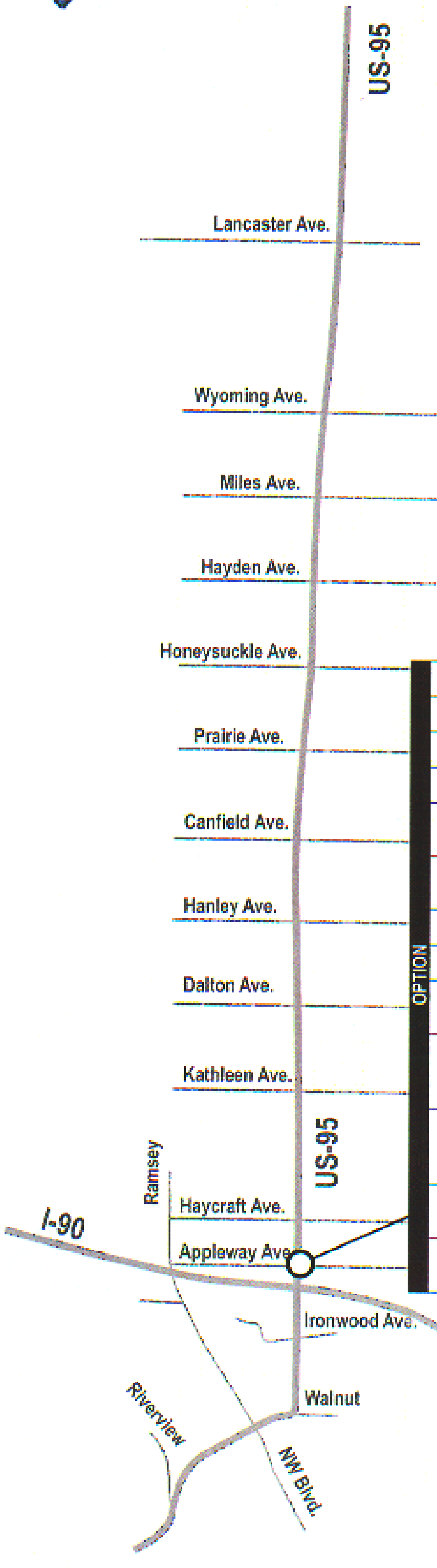
Exhibit 2D



OPTION	INTERSECTION TOTAL	EB LEFT	EB THROUGH	WB LEFT	WB THROUGH	NB LEFT	NB THROUGH	SB LEFT	SB THROUGH
Existing	E / 70.6	E / 64.3	C / 27.6	D / 46.6	F / 133.9	E / 66.3	E / 57.1	E / 72.4	F / 90.9
2020 No-Build	E / 76.2	F / 140.7	D / 36.1	E / 67.2	F / 93.6	F / 121.5	E / 68.4	F / 99.3	F / 82.2
Local Arterial Improvements	E / 65.5	F / 135.4	C / 31.9	F / 85.1	E / 75.7	F / 100.4	E / 76.2	D / 49.1	D / 47.6
Huetter Road Alt Route	D / 41.8	D / 53.8	C / 27.3	C / 30.7	D / 36.2	D / 53.1	D / 43.3	D / 41.4	D / 52.3
US-95 Expressway with Overcrossings and Frontage Roads	D / 53.0	E / 73.9	C / 32.1	D / 35.2	E / 70.2	C / 31.5	E / 70.1	E / 72.8	C / 28.7
US-95 with Interchanges at Major Intersections	E / 64.1	F / 121.2	D / 47.0	E / 59.4	F / 85.9	D / 48.1	E / 65.5	F / 80.5	D / 38.8
Median U-Turns at Major Intersections	E / 76.2	F / 140.7	D / 36.1	E / 67.2	F / 93.6	F / 121.5	E / 68.4	F / 99.3	F / 82.2
Widen US-95 to 6-Lanes	E / 56.2	F / 121.4	D / 41.9	E / 94.9	F / 80.0	E / 65.6	D / 52.2	F / 102.6	D / 35.3
Huetter Road Alt Route with Southern Extension	D / 42.5	F / 145.3	C / 24.0	D / 35.2	C / 28.6	C / 31.4	D / 37.8	D / 38.6	D / 46.4
Huetter Road Alt Route with Southern Extension and 6-Lanes on US-95	D / 42.5	F / 171.6	C / 24.5	C / 34.6	C / 30.5	C / 29.8	D / 53.8	E / 42.2	C / 25.4
Huetter Road Alt Route with Southern Extension and US-95 Expressway	E / 59.1	E / 79.5	C / 33.4	C / 34.1	E / 79.8	C / 29.2	E / 79.9	E / 79.5	C / 31.9
Huetter Road Alt Route with Local Arterials	D / 37.8	F / 133.3	C / 22.9	D / 35.8	C / 28.6	C / 34.8	C / 33.8	D / 39.8	D / 37.1
US-95 Expressway with Local Arterial Improvements	C / 31.1	D / 46.8	C / 21.9	D / 36.4	D / 42.3	D / 47.1	C / 31.4	D / 35.7	C / 21.8

X / X = LOS / VEHICLE DELAY (SECONDS PER VEHICLE)

= LOS A
= LOS B
= LOS C
= LOS D
= LOS E
= LOS F

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Part 3 US 95 Signal System Analysis - Interim Conditions

Purpose

The purpose of this analysis is to review the existing signal system with respect to potential operations in the interim (2010) prior to the full corridor improvements taking place. In summary this signal system assessment focuses on the following areas:

- Review of potential signal timing and signal system improvements;
- Review existing corridor travel times via GPS runs along the corridor;
- Impact of ½-mile intersection spacing on corridor progression;
- 2010 interim improvement assessment; and
- ITS applications.

Methodology

Synchro 4.0 (1997 HCM methodology) was used to conduct this additional analysis. This analysis differs from the previous alternatives analysis, which was conducted using Signal 97. Upon full examination of the baseline data, we opted to use Synchro for the signal system analysis in order to achieve (1) consideration of system-wide operations and performance, and (2) ability to test and summarize several additional signal system improvement options. For purposes of the 2010 analysis, and considering the use of the two software packages, the results of the analysis should be reviewed in terms of the relative benefit and should not be compared directly to the results of the 2020 analysis. Synchro level of service results tend to be more conservative than those previously published which were calculated using Signal 97.

Assumptions

A certain number of assumptions have been made in the development of the forecast volumes for the corridor as well as in the evaluation of the signal operations along the corridor.

As described in the *Forecast Volumes* section, the evaluation of the ½-mile intersection signal spacing at Wilbur is being conducted as a result of potential development west of US 95. The additional traffic related to this development was added to the US 95 corridor based on existing patterns.

The future intersection signal analysis (2010), assumed that signal timing would be optimized. This includes the intersection splits and offsets. The overall cycle length was kept consistent at 140 seconds. Review of the timing cards indicates that at some crossing the pedestrian clearances are set such that they are required to cross US 95 during two separate phases. The minimum splits assumed in the Synchro analysis did not incorporate the pedestrian clearances. Synchro conducts a range of operational calculations at each intersection, looking at different percentiles of the traffic volumes entering the intersection. It then combines these to provide an estimate of average conditions at an intersection, which could be considered as typical for the time period analyzed. The splits used to evaluate the signal operations are also considered to be the average splits. To assume the pedestrian clearances as the minimum split, each would overstate intersection delay, as pedestrian activity is limited in the study area. Instead it should be recognized that in the event that a pedestrian call is triggered, the signal would revert to the required minimums. In the event of this, US 95 traffic may incur slightly more delay than reported for average conditions due to the longer splits on the side streets.

Forecast Volumes

Two sets of volume forecasts (PM Peak Hour) were used for this particular analysis. The first forecast volume set was used to evaluate the ½-mile intersection spacing. The purpose of the ½-mile intersection spacing

Table 5

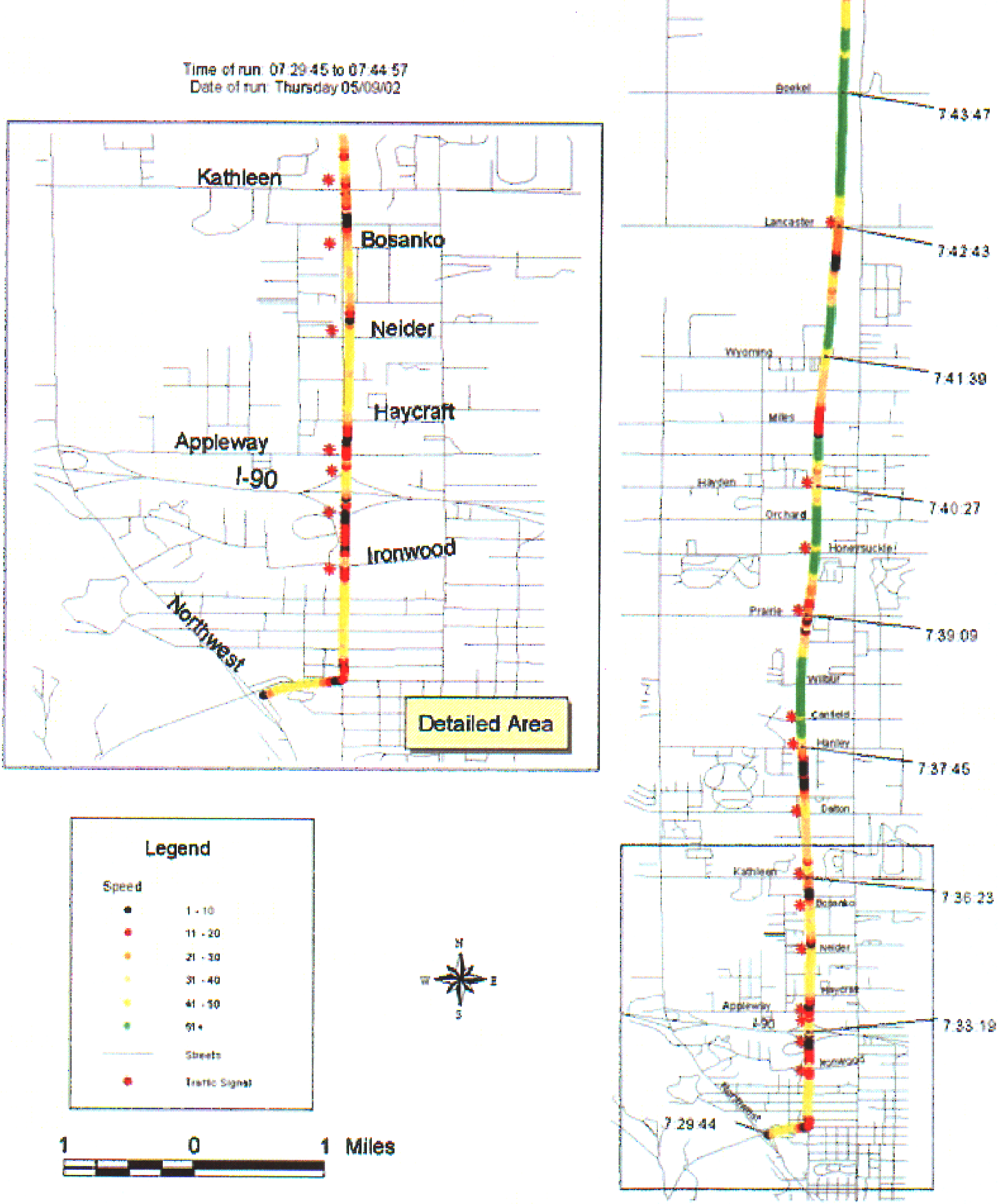
Existing and Optimized Intersection Timing Levels of Service – PM Peak Hour

Intersection		ITD Signal Timing			No Pedestrian Attributes[4]		
		LOS[1]	Delay[2]	V/C[3]	LOS	Delay	V/C
Hayden Ave	Overall	C	30.5	0.62	C	29.3	0.64
	NB/SB	C/C	20.7/22.8	0.60/0.39	C/C	28.6/26.5	0.67/0.45
Prairie Ave	Overall	F	110.3	1.10	F	85.8	1.06
	NB/SB	F/F	151.1/89.2	1.23/1.09	E/E	77.8/63.1	1.07/1.00
Canfield Ave	Overall	D	44.4	0.93	B	10.3	0.62
	NB/SB	A/A	3.4/8.3	0.67/0.46	A/A	3.4/8.3	0.67/0.46
Hanley Ave	Overall	D	43.9	0.82	B	17.9	0.66
	NB/SB	A/B	8.7/13.5	0.75/0.52	A/B	8.7/13.5	0.75/0.52
Dalton Ave	Overall	D	37.9	0.61	B	15.9	0.63
	NB/SB	A/B	7.0/10.6	0.65/0.59	A/B	7.0/10.6	0.65/0.59
Kathleen Ave	Overall	F	84.7	1.17	D	37.1	0.72
	NB/SB	B/D	15.5/44.1	0.75/0.67	B/D	15.5/44.1	0.75/0.67
Bosanko Ave	Overall	B	12.9	0.57	B	11.1	0.58
	NB/SB	A/B	2.5/13.4	0.57/0.65	A/B	2.5/13.4	0.57/0.65
Neider Ave	Overall	A	8.4	0.58	A	8.9	0.57
	NB/SB	A/A	6.6/1.7	0.61/0.57	A/A	6.6/1.7	0.61/0.57
Appleway Ave	Overall	D	53.4	0.78	D	37.4	0.76
	NB/SB	C/C	24.2/28.8	0.73/0.72	C/C	24.2/28.8	0.73/0.72
I-90 WB	Overall	B	17.0	0.60	B	11.4	0.60
	NB/SB	A/A	0.5/7.9	0.55/0.64	A/A	0.5/7.9	0.55/0.64
I-90 EB	Overall	C	29.3	0.77	C	20.8	0.77
	NB/SB	C/A	23.6/5.3	0.85/0.38	C/A	23.6/5.3	0.85/0.38
Ironwood Ave	Overall	D	43.0	0.78	D	46.4	0.77
	NB/SB	D/D	53.3/35.6	0.79/0.43	D/D	53.3/35.6	0.79/0.43

1. Level of Service
2. Delay expressed in seconds per vehicle
3. Volume-to-capacity ratio
4. Assumptions:
   - All pedestrian attributes removed from signal timing.
   - All split phasing removed, lefts now operate protected
   - All signal splits and offsets optimized

In addition to removing the pedestrian clearances and optimizing the signal timing, the system could further be improved via the implementation of ITS strategies along the corridor. With the configuration of the existing signal system it is difficult to monitor traffic flows and determine if the system is truly optimized. There are several ITS elements that could be implemented to help in this process. Based on studies published for other

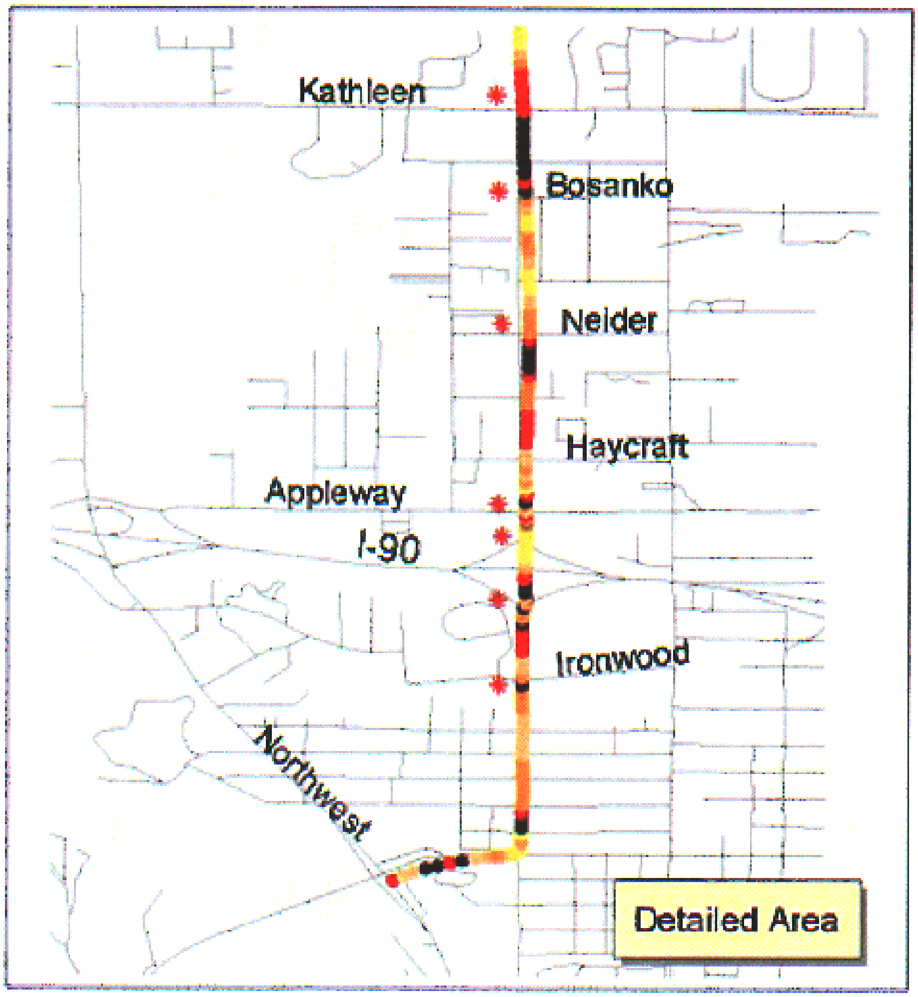
US 95 Northbound Travel Times AM Peak Hour - Exhibit 3

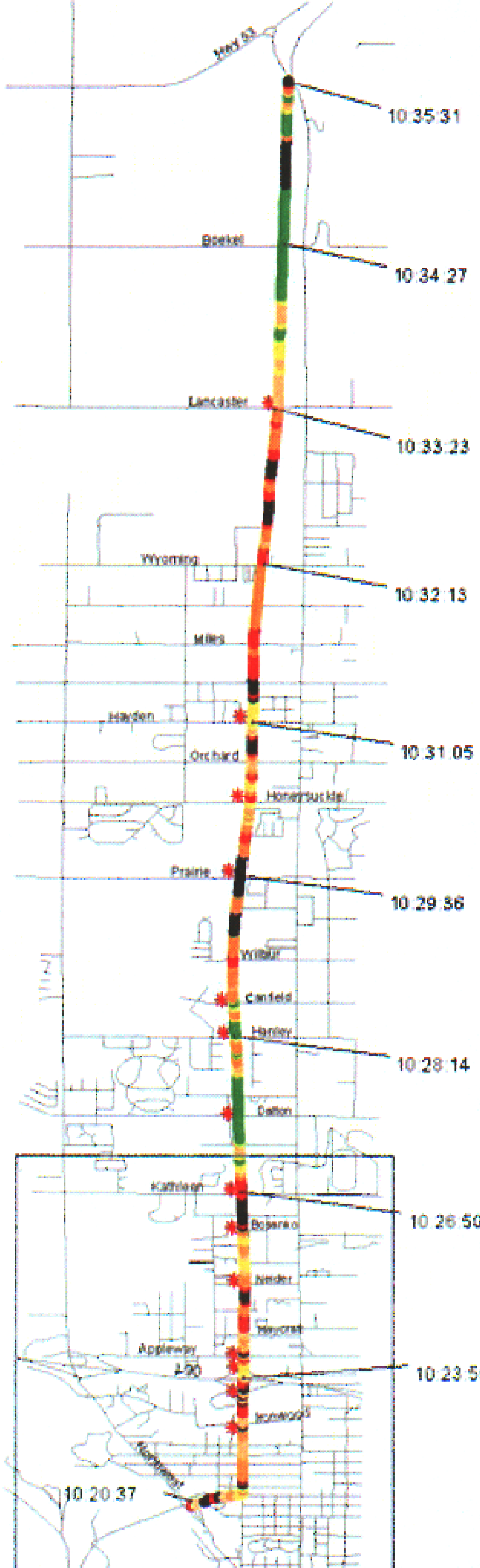


Street Map Source: 2000 U.S. Census, TIGER File

US 95 Northbound Travel Times
Midday - Exhibit 5

Time of run: 10:20:37 to 10:35:31
Date of run: Thursday 05/09/02

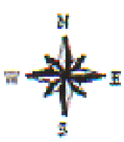




Legend

Speed

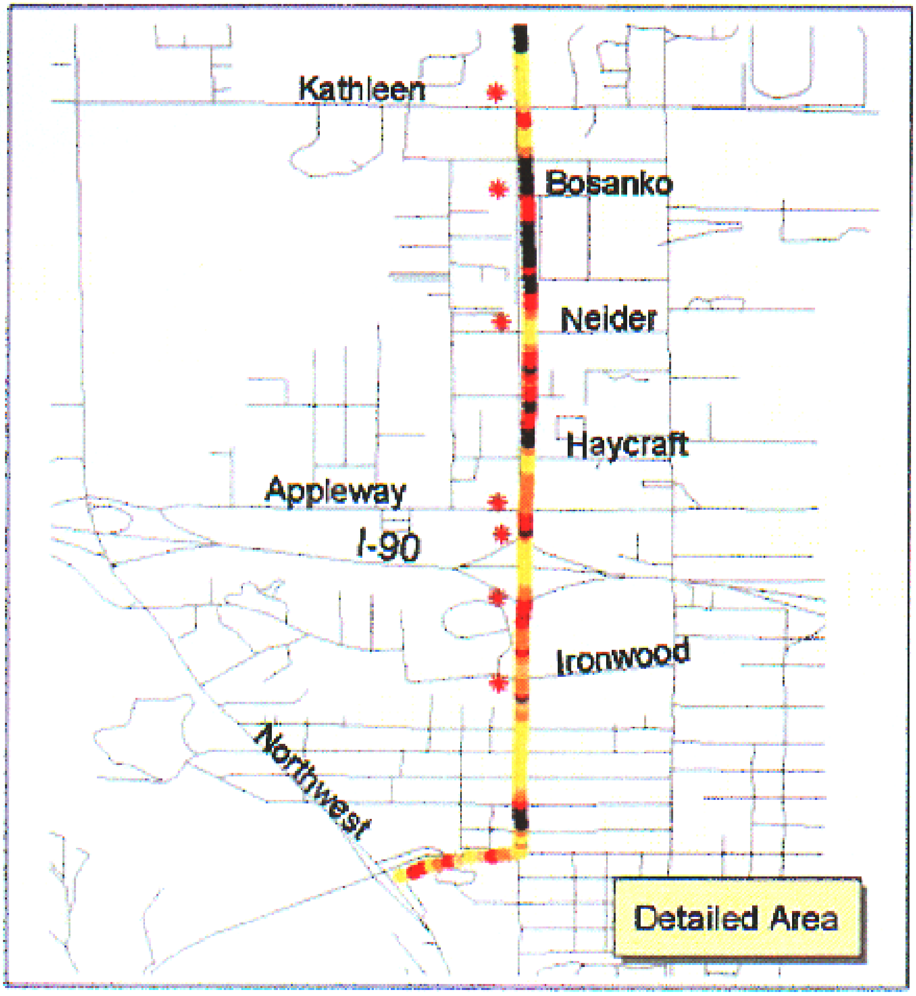
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 +
- Streets
- Traffic Signal

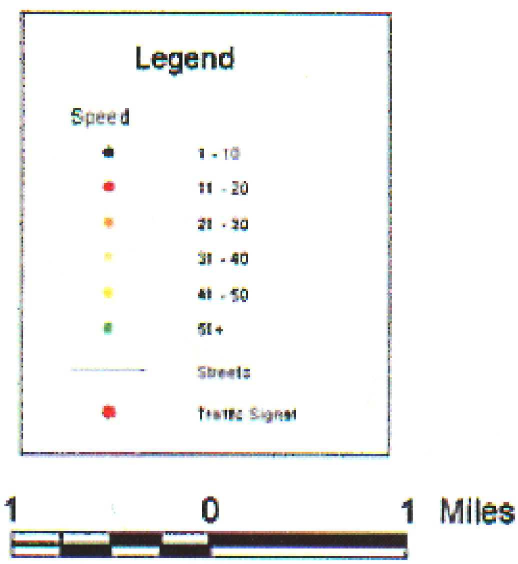


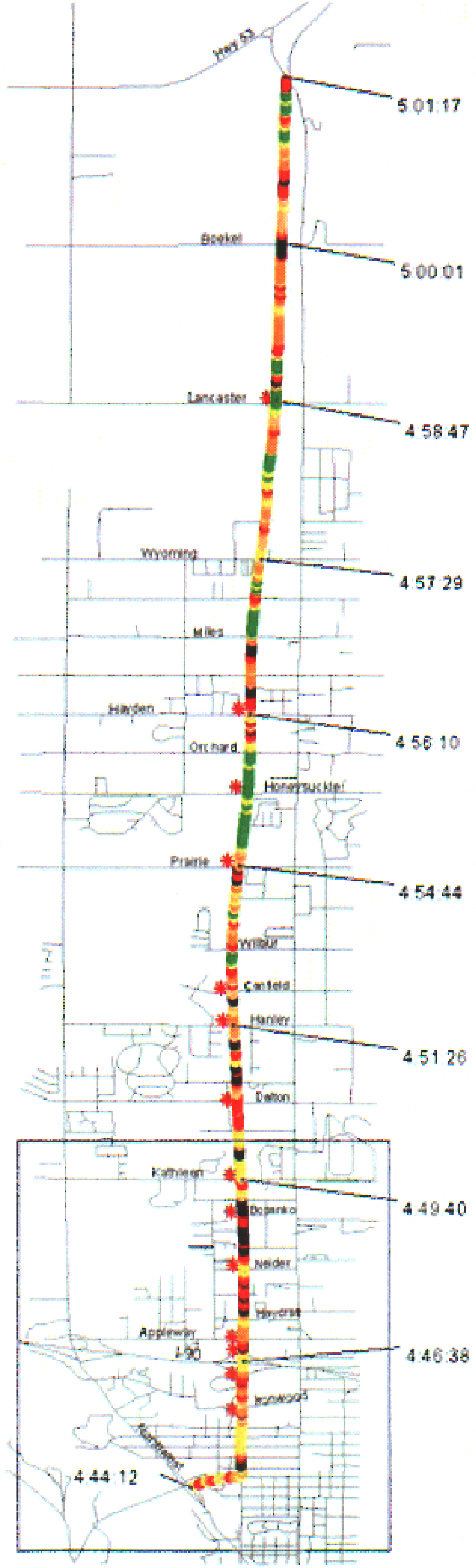
Street Map Source: 2000 U.S. Census, TIGER File

US 95 Northbound Travel Times
PM Peak Hour - Exhibit 7

Time of run: 4:44:12 to 5:01:17
Date of run: Thursday 05/09/02







Street Map Source: 2000 U.S. Census, TIGER File

The time-space diagrams generated from the Synchro report are shown in the following to figures. Time-space diagrams were included for both with and without the signal at Wilbur Avenue.

Exhibit 9. Existing Green Band When Viewing Canfield to Prairie as an Isolated System

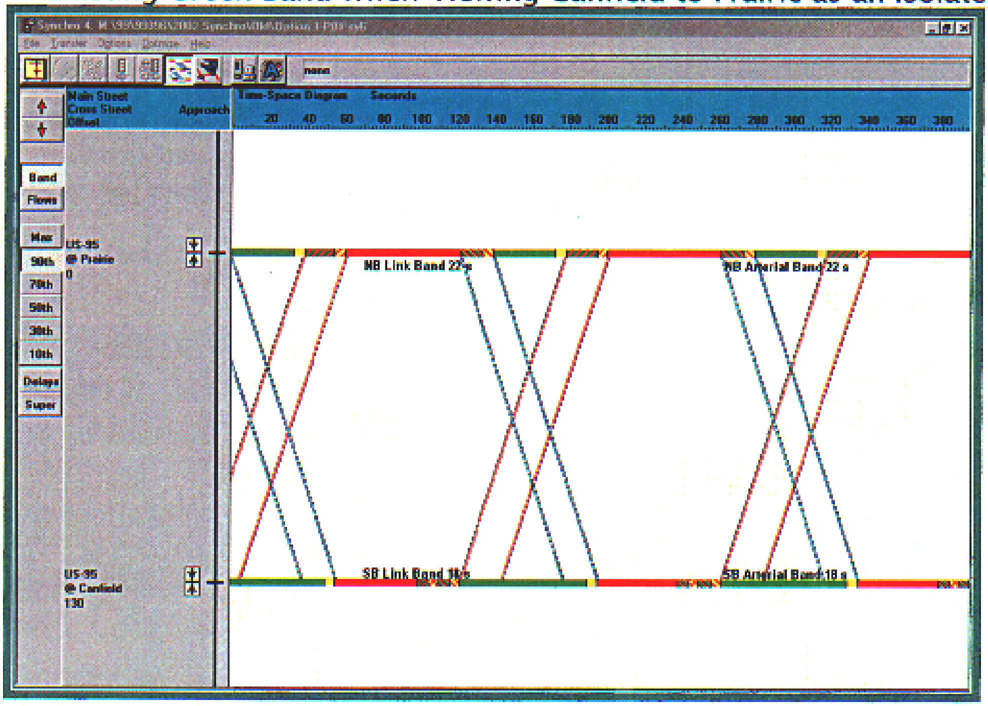


Exhibit 10. Future Green Band with a Signal at Wilbur When Viewing Canfield to Prairie as an Isolated System

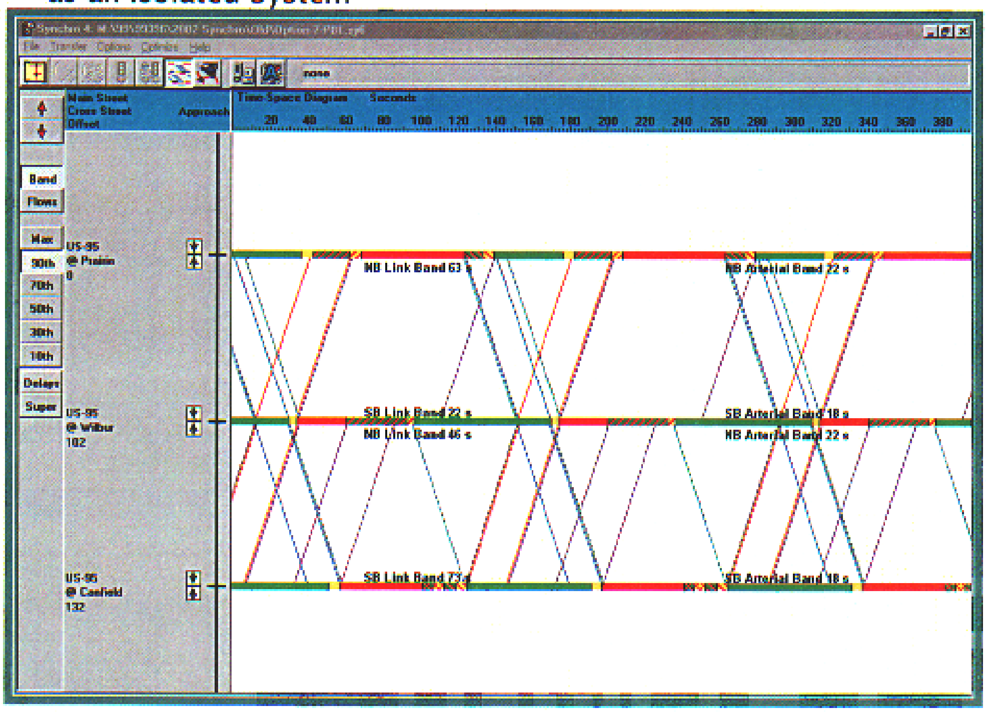


Table 7

Level of Service Summary – 2010 PM Peak Hour

Intersection		Future Without Improvements			Future With Improvements		
		LOS[1]	Delay[2]	V/C[3]	LOS	Delay	V/C
Hayden Ave	Overall	D	52.0	0.78	C	25.9	0.72
	NB/SB	D/C	54.2/27.2	0.78/0.47	B/C	13.6/28.9	0.75/0.51
Prairie Ave	Overall	F	221.9	1.37	E	69.9	1.07
	NB/SB	F/F	300.7/233.0	1.57/1.40	E/D	59.4/36.4	1.09/0.98
Wilbur Ave	Overall	C	29.8	1.02	B	10.9	0.83
	NB/SB	B/B	17.1/14.4	0.92/1.00	A/A	5.6/4.1	0.77/0.84
Canfield Ave	Overall	E	56.3	1.19	B	16.9	0.79
	NB/SB	C/C	30.9/20.9	0.95/0.66	A/B	6.7/18.7	0.86/0.60
Hanley Ave	Overall	F	81.1	1.07	B	17.0	0.80
	NB/SB	F/C	146.4/28.1	1.18/0.80	B/A	10.4/5.0	0.88/0.63
Dalton Ave	Overall	D	42.7	0.82	B	18.3	0.73
	NB/SB	D/D	40.7/39.2	0.85/0.78	A/B	7.5/19.5	0.79/0.73
Kathleen Ave	Overall	F	122.4	1.47	C	32.9	0.86
	NB/SB	C/D	33.9/44.9	0.87/0.88	D/B	39.7/12.6	0.90/0.82
Bosanko Ave	Overall	B	14.7	0.72	B	13.8	0.70
	NB/SB	A/B	3.1/20.0	0.72/0.81	A/B	3.8/15.8	0.72/0.77
Neider Ave	Overall	B	12.5	0.72	B	10.1	0.70
	NB/SB	B/A	11.1/6.9	0.80/0.76	A/A	6.3/2.9	0.75/0.74
Appleway Ave	Overall	E	71.1	0.98	C	34.8	0.83
	NB/SB	E/E	63.7/71.6	0.95/0.99	C/C	29.2/23.7	0.81/0.84
I-90 WB	Overall	C	29.8	0.75	B	12.9	0.75
	NB/SB	B/C	17.9/21.5	0.73/0.54	A/A	0.4/8.1	0.61/0.73
I-90 EB	Overall	D	40.7	0.96	C	29.6	0.96
	NB/SB	D/B	37.6/12.2	0.91/0.42	C/A	29.6/2.7	0.97/0.44
Ironwood Ave	Overall	E	59.8	0.97	D	39.4	0.79
	NB/SB	E/C	75.0/30.6	0.98/0.56	D/B	50.6/11.0	0.83/0.45

1. Level of Service
2. Delay expressed in seconds per vehicle
3. Volume-to-capacity ratio

As shown in Table 7, intersection levels of service are shown to improve by one to two levels with the proposed improvements when looking at the overall intersection operations. Also shown are the impacts of the potential side street improvements to the northbound and southbound through movements on US 95, which can be seen to improve at the majority of locations. This can be attributed to the additional green time allocated to the US 95 northbound/southbound movements, the result of the side streets needing less green time due to the potential improvements.

Scope and Budget

Without conducting a detailed analysis, it is difficult to provide a precise estimate of the budget necessary to complete a system as described above. Although a detailed analysis has not been completed focusing, it is envisioned that the arterial management system could extend from Ironwood north to Hayden. This section is approximately 4 miles long and includes 12 signals. Due to the close spacing of Government Way to US 95, it is assumed that signals along Government Way at the major 1-mile spacing be coordinated and interconnected as part of the arterial management system. Table 8 provides a list of the key components identified as part of the system and an estimated cost for each. The costs highlighted for each element are based on typical costs for installation and equipment, using 2002 dollars.

Table 8

ITS Cost Estimate

Component	Number	Cost per unit	Total Cost
Upgrade signal controller/detection	10 - 15 signals	35 k per signal	350 - 525 k
Fiber optic communication	5 - 10 miles	75 k per mile	375 - 750 k
Surveillance cameras	5 sites	35 k per site	175 k
Traffic management software (video and signal control management	2 servers 1 software package	Server = 10 k Software = 20 k	20 k 20 k
Total Cost			**940 k - 1.49 million**

Results

A detailed summary of the results of the unsignalized analysis is included in Exhibit 11. As shown, LOS on US 95 will be acceptable in 2020 under all of the options analyzed, however, delay on the side street movements is anticipated to be higher with the median protection improvements needed for all of the options studied, than in 2020 baseline conditions.

Part 5 Rural Highway Levels of Service

Purpose

To ascertain the performance of US 95 based on future traffic operations along the rural portion of the study area south of the Spokane River to Mica Creek.

Methodology

An evaluation of future (2020) rural highway LOS was conducted for the portion of US 95 south of the Spokane River.

The criteria used in this study are based on levels of service for two-way rural highways (one lane in each direction), as described in Chapter 8 of the HCM. This methodology was used to evaluate the operation of US 95 south of the Spokane River Bridge, even though some portions of the highway have two lanes in each direction, or an uphill climbing lane. The operation of a rural two-lane highway is defined in terms of service grades ranging from LOS A (best) to LOS F (worst). The primary measure of service quality for rural arterials is *percent time delay*, with *speed* and *capacity utilization* used as secondary measures, which are described next:

4. **Average Travel Speed.** The traveling speed of a motorist using the roadway.
5. **Percent Time Delay.** Average percent of the total travel time that motorists are delayed in platoons (i.e. behind slow-moving car) while traveling on the roadway.
6. **Capacity Utilization.** The volume-to-capacity (v/c) ratio of the roadway. The v/c ratio is somewhat different from those used for intersections. The values for rural arterials represent the ratios of flow rate to "ideal capacity," which is 2,800 pcph for level terrain with ideal geometrics and zero percent passing zones.

Average travel speed is not a meaningful indicator of LOS where posted speed limits have been restricted below 60 mph. This is the case as US 95 approaches Coeur d'Alene from the south, where the speed limit drops from 60 to 45 mph. Where the speed limit is below 60 mph, percentage of time delay and capacity utilization (v/c) are the only meaningful indicators of LOS. The LOS criteria for rural arterials are given in Table 10. For each LOS, the percent time delay and v/c ratios are shown for both level terrain and rolling terrain.

Table 10

HCS LOS Criteria
Rural Highways

LOS	Percent Time Delay	V/C Ratio Level Terrain	V/C Ratio Rolling Terrain
A	0-30	0.00-0.07	0.00-0.05
B	31-45	0.08-0.19	0.06-0.17
C	46-60	0.20-0.34	0.18-0.32
D	61-75	0.35-0.59	0.33-0.48
E	76-99	0.60-1.00	0.49-0.91
F	100+	1.00+	0.92+

Table assumes 60 percent No-Passing zones.

capacity at the lower boundary of LOS B. Drivers are delayed up to 45 percent of the time on average. Service flow rates of 750 pcph, total in both directions, can be achieved under ideal conditions. Greater than this flow rate, the number of platoons forming in the traffic stream begins to increase dramatically.

LOS C characterizes noticeable increases in platoon formation, platoon size, and frequency of passing impediment. Average speed still exceeds 52 mph on level terrain, even though unrestricted passing demand exceeds capacity. At higher volume levels, chaining of platoons and significant reductions in passing capacity begin to occur. While traffic flow is stable, it is becoming susceptible to turning traffic and slow-moving vehicles. Percent time delays are up to 60 percent. A service flow rate of up to 1,200 pcph, total in both directions, can be accommodated under ideal conditions.

LOS D characterizes unstable flow approaches. The two opposing traffic streams essentially begin to operate separately at higher volume levels, as passing becomes extremely difficult. Passing demand is very high, while passing capacity approaches zero. Mean platoon sizes of five to ten vehicles are common, although speeds of 50 mph can still be maintained under ideal conditions. The fraction of no passing zones along the roadway section usually has little influence on passing. Turning vehicles and roadside distractions cause major shockwaves in the traffic stream. The percentage of time motorists are delayed approaches 75 percent. Maximum service flow rates of 1,800 pcph can be maintained without a high probability of breakdown.

LOS E means that, even under ideal conditions, speeds will drop below 50 mph. Average travel speeds on highways with less than ideal conditions will be slower, as low as 25 mph on sustained upgrades. Passing is virtually impossible under LOS E conditions, and platooning becomes intense when slower vehicles or other interruptions are encountered. The highest volume attainable under LOS E defines the capacity of the highway, 2,800 pcph, is the total for both directions. Traffic conditions are seldom observed near capacity on rural highways, primarily because of a lack of demand.

LOS F represents heavily congested flow with traffic demand exceeding supply. Volumes are lower than capacity and speeds are below capacity speed. LOS E is seldom attained over extended sections in level terrain as more than a transient condition; most often, perturbations in traffic flow as LOS E is approached cause a rapid transition to LOS F.

The Idaho Transportation Department considers roadways which are providing approximately LOS D or less are considered to be "at or near" congestion. Table 12 shows the volume to capacity ratios that define these conditions.

Table 12

Volume to Capacity Ratios

Roadway Classification	Near Capacity		At Capacity	
	Urban	Rural	Urban	Rural
Interstate	0.66	0.75	0.83	0.92
Two-Lane Highway	0.60	0.39	1.00	0.62
Three or more lane Highway	0.79	0.75	1.00	0.89

Assumptions

The assumptions used in this analysis were based on information obtained from Idaho Department of Transportation's Grail software package, and from video footage of the segment. A summary of this information is included in Exhibit 4A.